

### **REMARKS**

The Examiner is thanked for the careful review of this Application. Claims 6, 8, and 26-35 are pending after entry of the present Amendment. Claims 1-5, 7, and 9-25 were previously cancelled. Claims were amended to better define the invention and to correct typographical errors. The amendments do not introduce new matter.

#### **Claim Objections:**

Per Office's request and for the purpose of clarity, claims 8, 26, 27, 29-33, and 35 have been amended to correctly recite the article "The." As such, it is respectfully requested that objection to claims 8, 26, 27, 29-33, and 35 be withdrawn.

#### **Rejections under 35 U.S.C. § 103(a):**

The Office has maintained the 35 U.S.C. § 103(a) rejections of claims as being unpatentable over U.S. Patent No. 6,333,255 to Sekiguchi in view of U.S. Patent No. 6,277,728 to Ahn et al. ("Ahn"). The Office has further rejected claims 6, 8, and 26-35 under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 6,717,267 to Kunikiyo in view of Ahn. The Applicants respectfully submit that rejection of claims under any combination of the cited prior art should be withdrawn at least in view of the amendments made to independent claims 6, 28, and 34 and the accompanied remarks. Specifically, amendments were made to independent claims 6, 28, and 34 so as to overcome the Office's interpretations provided in the Office Action, date July 14, 2004.

Independent claim 6 has been amended to specifically recite that the supporting column formed by the plurality of supporting stubs maintains structural contact with the passivation layer. Thus, the supporting column of the claimed invention is not disposed over the source/drain region because (a) the passivation layer is formed over the ILD; and (b) the ILD is formed over the substrate that includes the source/drain regions (i.e., the ILD separates the passivation layer from the source/drain regions). Additionally, claim 6 has been amended to specifically recite that electrical connection between the supporting column and the metallization lines and conductive vias is avoided because the supporting column maintains structural contact with the passivation layer. Additionally, as provided by the Applicants in page 13, lines 16-19, the plurality of supporting stubs are configured so as to not provide electrical connection between the plurality of interconnect levels of the semiconductor device. As such, the supporting stubs of the claimed invention do not have electrical functionality because (a) the metallization lines and vias are used to provide electrical interconnection in the semiconductor; (b) The supporting stubs are not electrically interconnected with the metallization lines and vias; and (c) the claim language was amended to make clear that the supporting columns do not provide electrical connection between the interconnect levels.

Citing to Sekiguchi, the Office has specifically interpreted that the two inside "lines" taught in Sekiguchi are not electrically connected to the plurality of interconnect metallization lines and conductive vias. The Applicants respectfully draw the Office's attention to Figures 1(a)-9 wherein the Applicants' interpretation that the two inside wires as well as the two outside wires in Sekiguchi are formed directly over the source/drain regions, is confirmed. As such, the two inside wires to enable flow of current from the transistors to the multiple levels of the semiconductor structure. Furthermore, Sekiguchi fails to disclose, teach, or suggest altering the function of the two inside lines from carrying signals to providing support but not carrying signals. Sekiguchi further fails to disclose, teach, or suggest a plurality of supporting stubs that are configured so as to not provide electrical connection between the interconnect levels.

In the same manner, Kunikiyo fails to teach or suggest the claimed invention, as the semiconductor device taught in Kunikiyo uses dummy plugs and dummy interconnection lines. The dummy plugs are used to interconnect the dummy interconnection lines. Kunikiyo teaches that the dummy interconnection lines are defined in the same layers as the metallization interconnect lines used to carry signals. Thus, contrary to the claimed invention, the dummy plugs of Kunikiyo are not formed as a supporting column that extends through the plurality of interconnect levels. Specifically, because the interconnect lines are formed in the same layers as the metallization lines, unless a metallization line is defined in each interconnect level, some of the interconnect levels may not include dummy plugs. Figure 12 of Kunikiyo confirms the Applicants' interpretation. In Figure 12 of Kunikiyo, dummy interconnection 21B is defined in the dielectric 10 such that the dummy interconnect is not in contact with the interlayer film 5. As can be seen, in contrast to the claimed invention, the dummy interconnect does not form a supporting column that is disposed over the passivation layer and that extends through the plurality of interconnect levels so as to provide structural integrity. As further illustrated in Kunikiyo, the dummy plugs are separated from one another with dummy metallization lines. As such, the dummy plugs cannot form a supporting column that extends through the interconnect layers, as defined in the claimed invention.

Given that Kunikiyo specifically uses the dummy plugs to provide connection between the interconnect lines, one of ordinary skill in the art would not have gone against the explicit teachings of Kunikiyo and use the dummy plugs to provide structural integrity and not electrical connection. In the same manner, Kunikiyo fails to disclose, teach, or suggest forming the dummy plugs and dummy interconnection lines in the manner the plugs and interconnect lines are aligned (i.e., such that a supporting column can be formed), as provided in the claimed invention.

It must be noted that the dummy plugs and dummy interconnection lines used in Kunikiyo have specific functions. First, the dummy plugs and interconnection lines are used

to provide electrical connection between the interlevel layers. In one embodiment, the dummy interconnections and dummy plugs are electrically interconnected through an upper level dummy interconnection. In a different embodiment, the dummy interconnections and dummy plugs are connected to an interconnect that carries a constant potential. In either embodiment, the dummy plugs and interconnections are explicitly taught to be able to provide electrical connection. To arrive at the claimed invention, one of ordinary skill in the art would have to go against the specific teachings of Kunikiyo to form the supporting stubs of the claimed invention (i.e., supporting stubs that do not provide electrical connection). In fact, in preferred embodiment of Kunikiyo, the potential of the dummy conductors is fixed at a stable potential which can be the closest potential to the potential carried on an adjacent conductor or a stable potential that is different from the closest potential carried on the adjacent conductor, depending on the scenario. In column 15, lines 63-67, Kunikiyo provides:

Generally, fixing the dummy interconnections at a stable potential enhances the effect of suppressing the noise imposed on the interconnection or cross talk through the shielding effect of the dummy interconnections.

Again, given such teachings, one of ordinary skill in the art would have to go against the explicit teachings of Kunikiyo to arrive at the supporting stubs that are configured so as to not provide electrical connection between the interconnect levels. Accordingly, Kunikiyo and Sekiguchi both fail to disclose, teach, or suggest all the elements of the claimed invention.

Even if the porous low-K dielectric of Ahn were to be used in the multilevel structure of Sekiguchi or Kunikiyo, one of ordinary skill in the art would not have arrived at the claimed invention. In the claimed invention, as defined in independent claim 6, the plurality of copper interconnect metallization lines and conductive vias are separated by a porous dielectric material. In Sekiguchi, however, even though the carbon insulating layers or the silicon dioxide layers have been etched, the upper and lower silicon dioxide or silicon nitride layers are remained intact to provide and maintain the structural integrity of the multilevel semiconductor device. As such, one of ordinary skill in the art modifying the dielectric layer of Sekiguchi with the porous low-K dielectric material of Ahn would not have arrived at the claimed invention because the semiconductor structure would have a higher dielectric constant than the semiconductor of the claimed invention wherein the interconnect metallization lines and conductive vias are isolated by porous dielectric material.


In the same manner, Kunikiyo defines an interlayer film between each of the two consecutive interlayer dielectric layers. Again, even if Kunikiyo were to be modified and the porous dielectric material of Ahn were to be used for the interlayer layers, the interlayer films still remain intact, as shown in Figures 9 and 12, for example. As interlayer films are

taught to be dielectrics, the resulting semiconductor would have a higher dielectric constant than the semiconductor device of the subject invention.

Yet further, independent claims 28 has been amended to specifically recite that the metallization lines and conductive vias are isolated from each other by only a porous dielectric material. In the same manner, independent claim 34 has been amended to recite that the metallization lines and conductive vias are isolated from each other by either only a porous dielectric material or only a mixture of a porous dielectric material and gaseous dielectric. As claimed and as also acknowledged by the Office, the structures of Sekiguchi and Kunikiyo have higher dielectric constants than the semiconductor device of the claimed invention. Furthermore, it must be noted that in contrast to the claimed invention, as defined in claims 28 and 34 wherein a passivation-capping layer is implemented, Kunikiyo does not disclose, teach, or suggest using a passivation-capping layer.

Accordingly, for at least the above-stated reasons, independent claims 6 and 28 are patentable under 35 U.S.C. § 103(a) over Sekiguchi in view of Ahn and independent claims 6, 28, and 34, are patentable under 35 U.S.C. § 103(a) over Kunikiyo in view of Ahn. Claims 8, 26, and 27, 29-32, and 35, each of which ultimately depends from the applicable independent claim 6, 28, and 34 are likewise patentable under 35 U.S.C. § 103(a) over any combination of the cited prior art for at least the same reasons set forth for the applicable independent claim.

In view of the foregoing, the Applicants respectfully submit that all of the pending claims are in condition for allowance. Accordingly, a Notice of Allowance is respectfully requested. If the Examiner has any questions concerning the present Amendment, the Examiner is kindly requested to contact the undersigned at (408) 749-6900, ext. 6913. If any additional fees are due in connection with filing this Amendment, the Commissioner is also authorized to charge Deposit Account No. 50-0805 (Order No. LAM2P246). A duplicate copy of the transmittal is enclosed for this purpose.

Respectfully submitted,  
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